Biotic interactions and biodiversity-environment relationships from local to global scales

Jonathan Myers (Washington University, St. Louis, MO), Joseph A. LaManna, Dilys M. Vela Díaz, Scott A. Mangan, Marko J. Spasojevic, Christopher P. Catano, Laura A. Burkle, R. Travis Belote, J. Sebastián Tello, and the Smithsonian ForestGEO Network.

One of the most ubiquitous patterns of life on earth is the systematic increase in species diversity from temperate to tropical environments. Yet the processes underlying this and other prominent biodiversity-environment relationships have been difficult to distinguish because different processes operating at multiple scales determine geographic variation in biodiversity and community assembly. Despite decades of study, we still lack a synthetic understanding of how local biotic interactions interact with eco-evolutionary processes at larger scales to determine diversity-environment relationships and global patterns of biodiversity. Using high-resolution, stem-mapped forest plots at local, continental, and global scales, we show that systematic increases in the strength of negative densitydependent biotic interactions are associated with higher species diversity in resource-rich habitats, higher local species diversity and weaker habitat partitioning in productive regions, greater abiotic niche overlap in the tropics, and higher species diversity at tropical versus temperate latitudes. Moreover, densitydependent biotic interactions were stronger for rare than common species at tropical versus temperate latitudes, providing a mechanism to explain why large numbers of rare species persist in the tropics. Our results reveal fundamental differences in the nature of biotic interactions along environmental gradients that contribute to the maintenance of biodiversity from local to global scales.